THE ELECTRICAL WORLD

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A Convenient Testing Laboratory.

In a previous article on "Testing Laboratories" (Nov. 10, 1883), we pointed out the value of careful, accurate electrical tests and measurements, and we analyzed the conditions essential to convenience and precision in making these tests. We showed what precautions should be had in the disposition and installation of the apparatus in order to insure its delicate action and eliminate all disturbing causes, and, after emphasizing the importance of system and care in the manipulations, in order that the results may be reliable, we described some well-appointed laboratory installations made by a French electrician, M. J. Carpentier. We propose now to describe another of these "model" testing laboratories, which shows plainly how systematic arrangement of apparatus affords compactness and convenience. We have purposely selected this laboratory as an example, because it is so well fitted to answer the needs of those who have to test telegraph or telephonic lines and apparatus. This laboratory, which is illustrated in the accompanying figure, reproduced from *La Lumière Electrique*, is one used for testing purposes by the pupils of the "Ecole Supérieure de Télégraphie," in Paris.

In a laboratory intended for telegraphic tests, elaborate appointments are not necessary. With a Thomson reflecting galvanometer, a good electrometer, in addition to the usual accessories of Wheatstone bridges, rheostats and condensers, the most delicate tests required in telegraphy, and in telephony, can be made. This is all the apparatus we shall find in this case.

It is not a matter of very great difficulty to find a place for a laboratory where the proximity of moving masses of iron, which affect the delicacy of action of the galvanometer, are avoided. It is more difficult, however, to find a building where the floor, even though it rest on the ground, is free from tremors, which equally affect the delicacy of deflecting instruments. In this case the laboratory, which is placed in the rear, at some distance from the street, is on a ground floor that rests upon a bed of asphalt. To protect the deflecting instruments from tremors they are placed upon a massive table T about one metre and a half long and half a metre wide, resting upon four stone pillars $P\,P$ that are sunk about a foot deep into the ground. The solidity and stability of this stable is such that a person can stand upon it and jump up and down without causing the reflecting mirrors to move perceptibly. The apparatus comprises, as already stated, a reflecting galvanometer G of the Thomson pattern, and an electrometer E of either the Thomson quadrant, or of a modified form. In some cases an electro-dynamometer is also used. The electrometer, of course, requires certain accessories, such as the gauge J, an arrangement for determining whether the potential of the needle of the electrometer varies, and a replenisher r which is an apparatus for changing the potential of the needle when necessary.

The galvanometer rests on one end of the table and the electrometer on the other. Between them is placed a lantern L, from which they both receive the beam of light that serves as the "pointer" on the reading scales $r\,r$. The light-giving source in the lantern may be either a gas jet, an oil lamp, or a wax candle fed by a spring as it consumes. The light, passing out through the side openings, each of which is provided with lenses and with a "sight" hair or thread that divides the beam of light vertically by a shadow line, which is the reading line. By means of plane reflectors $M\,M$, the divided beam on one side is brought to the reflecting mirror of the galvanometer and by similar mirrors the divided beam issuing from the other side of the lantern is brought to the reflecting mirror of the electrometer. These reflecting mirrors in turn project these beams upon the reading scales $r\,r$ placed before them, where they appear as a round spot of light divided by a vertical shadow line. These scales consist of strips of glass divided in millimetres, and the shadow line is distinctly visible through them by the person making the tests. They are clamped to a board $R\,R$ carried on small brass columns $s\,s\,s$. which project upward from the table T^1. The scales can be moved sidewise as well as vertically, so that the spot of light may be brought to the desired point upon each scale. The mirrors $M\,M$ can also be moved in any position so as to change the angles of deflection, and thus it is possible to make the spot of light well defined. It will be noticed that there are three openings in the lantern L. The beam of light issuing from the front is thrown on the movable hair of the gauge J. There are two hair lines fixed horizontally a little in front of the movable hair. This portion of the apparatus is placed as nearly as possible in the focus of a small lens which produces an image of it on a small plate of ground glass e fastened to the replenisher, which is placed on the board R between the two reading scales. Thus the experimenter can tell, by looking at the image on the glass plate e whether the potential of the electrometer needle has varied, and the replenisher itself is conveniently situated, so that by turning the button v one way or the other the charge may be "replenished." Upon the table T which is made of oak, and of ample size, the experimenter can place the usual measuring accessories, such as Wheatstone bridges, rheostats condensers, galvanometer shunts, switches, keys, etc. The whole installation, as the figure clearly shows, is very small and compact, and yet it is very conveniently arranged. The experimenter sitting at the table has everything in sight and within easy reach; there is a place for everything and everything is in its place, and not only are delicate manipulations rendered less difficult, tests made more promptly and accurately, but the stock of patience and endurance of the experimenter is not so soon exhausted. If he has to work for several hours he will be less tempted to "expedite" his tests, and the "personal equation" to be taken into account in the results will be smaller than would be the case when the laboratory is not systematically arranged. There are many electricians who apologize for the disorder and want of regulation in the testing room by the plea that "the apparatus is not very delicate anyhow, so what's the good?" This is a poor excuse. It is a mistaken idea to think that only delicate apparatus should be used with eare. We know by experience that system, skill and care are quite as necessary as delicacy of action. The very fact that the apparatus is not so delicate as might be desired is the best reason why it should be used under the most favorable conditions possible.

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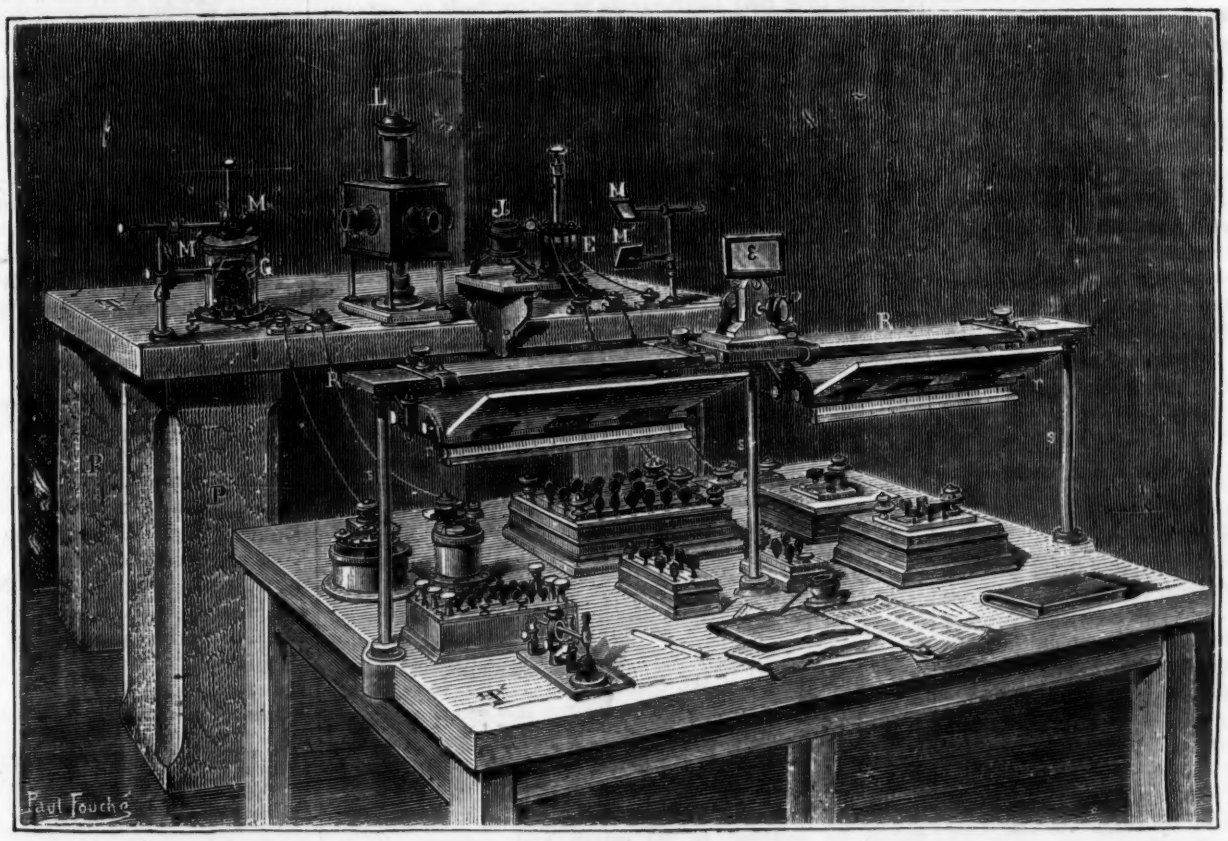

TESTING LABORATORY AT THE ECOLE SUPERIEURE DE TELEGRAPHIE, PARIS.

An Interesting Exhibition.

An exhibiton of their works was given on Feb. 22 says, the *Montreal Gazette*, in a long report of the event, by the American Electric and Illuminating Company, Mr. M. Lee Ross, the local manager showing a large number of gentlemen over the central lighting station on Inspector street and the factory on Dowd street. The visitors were very much pleased with the Thomson-Houston system, as explained and shown to them, for electric lighting, taking great interest in the generation of the current at the dynamos and in the operation of the lamps. The uses of electricity as a producer of heat were also demonstrated, and the party were served with eggs and coffee, cooked in a neat little electric stove, heat for which was supplied on the same circuit as that supplying the light. This, it was stated, was the first cooking ever done by electricity, and it was undoubtedly a success.

The transmission of power through five miles of wire was exemplified by the operations of a circular saw, the electric motor for which was controlled by one man by means of a most simple device.

The prospects of the company in Canada are of the most flattering character.

The Indianapolis Telephone Exchange.

Last week we gave an interesting description of the well-planned telephone exchange at Newark, N. J. The following relates to the Central Union Telephone Company's new exchange at Indianapolis, Ind., corner of Illinois street and Indiana avenue:

"Our State and outside business is now transacted in an entirely separate office from the city," explained Supt. Hackett, to a *Times* reporter, as a room was entered in which three young ladies were engaged in receiving and transmitting calls. "At least 150 places can now be connected with this city, the most distant points being Cincinnati, Toledo, Lafayette, Paris, Ill., Richmond and Vincennes."

The general exchange, which was next visited, was found to be a large, high and airy room on the third floor, the appearance of which, and indeed everything connected therewith, presented a most noted contrast with the miserably dark, cramped and ill-ventilated quarters formerly occupied in the old Western Union building. In the old exchange there used to be a constant and most confusing hum of conversation, as the girls at the several "receivers" have repeated the calls to their companions at the switch-boards.

"You notice a difference, don't you?" said Mr. Hackett. "The fact is there is no reason for any noise whatever here. There need not be a sound heard when we get everything working just as we expect to have it. Here is one of the young ladies who is wearing what we call a telephone cap, by which she wears a receiver to her ear all the time she is on duty. It seems to be a success. She suffers no inconvience from it and spares all the labor of lifting the receiver up and down to her ear, and is at the same time protected against any possible danger from an electric stroke during a thunder storm. When all the girls use these telephone cap receivers they will be able to hear and respond to calls with scarce a possibilty of delay or mistake, and the responds to the call can be done so quietly that there will be no noise or confusion to distract the attention of the oparators. Let me explain to you the plan upon which our switch-board is arranged. It extends, as you see, the entire length of the room. It has connection with about 1,200 telephones, with room on the switch-board for as many more. The feature of the plan upon which the switch-board is arranged is that while each operator has control of from seventy to ninety telephones for receiving calls, she has before her, within a distance of five feet, the facilities for direct connection with the entire list of subscribers. There is no calling to another operator to make the connection, which would involve delay and sometimes confusion and mistakes, but when a call comes in and the number required is ascertained all the operator has to do is to pull down one of a number of pegs which hang before her and insert it in the switch-board at the number required. Then the through connection is made. If the number called is talking with some other number on the switch-board, the operator discovers that to be the case by finding the number blocked when she attempts to insert the peg, and so informs the subscriber. When subscribers are informed that the party called for is talking they must accept that as final, and the operators are not allowed to argue the matter with them. The rules are so strict and the method of detection so easy and prompt that none of the operators will risk telling an untruth about the matter. All the responsibility, you see, now rests with one operator for responding to calls and making connections for a given set of numbers, and if a complaint comes there is no difficulty in at once locating the neglect. There can be no division of the blame, and that makes the operators careful, prompt and correct. When a call is made for an outside station the operator in the City Exchange connects the caller with the State Exchange by pressing her finger upon a little brass button on the table before her, and further communication is then made direct through the State Exchange. Our entire system is, we believe, as complete as that of any city in the United States—there are, in fact, only two other cities, Baltimore and Milwaukee, that have all the improvements which we have in use here."

Bell Telephone Business.

The net output of telephones for the month ended Feb. 20, the last of the fiscal year, says the Boston *Herald*, was 2,799, a decrease of 3,007 from 1883 and 2,407 from 1882. The earnings of the company depend in small part only upon the output of telephones, and will be large even if there be no increase the coming year. The net earnings for the year 1883–84 will probably be over $1,400,000. The output of telephones for three years past has been:

	1881–2.	1882–3.	1883–4.
March	4,593	5,192	4,739
April	5,331	6,690	7,342
May	5,757	7,469	6,758
June	5,735	6,362	7,038
July	4,288	3,787	5,846
August	5,021	4,678	3,569
September	3,024	4,276	4,365
October	4,140	4,136	3,706
November	4,943	5,033	3,811
December	5,080	4,532	4,191
January	3,687	4,744	3,164
February	5,206	5,806	2,799
Totals	56,755	69,705	57,328

The Telephone in Mexico.

The American Bell Telephone Company have given notice of the determination of the contract of February 12, 1881, on the 16th day of May next, under which the Mexican Telephone Company, by assignment from the Continental and Tropical American Telephone companies, secured the sole right to export telephones and telephonic apparatus from the United States into the republic of Mexico.

The question of a future contract for Mexico has not been determined or settled, says the Boston *Globe*, but, as the Mexican Telephone Company is bound by contracts with its sub-companies to furnish them with American Bell company's telephones, the question is quite a serious one for that company. The Tropical company have notified the Mexican company of this action by the American Bell Telephone Company.

With respect to the position of the Mexican Telephone Company the Boston *Herald* of the 21st says:

Mexican telephone was made active at $2\frac{1}{2}@2\frac{7}{16}$ regular and at various prices, with options attached, signifying a speculative movement. The cause of this activity is found in the fact that the American Bell Company has given notice of the determination of the contract of Feb. 12, 1881 (May 16, 1884). Three months' notice was required by either party before the contract could be annulled. As the Mexican company is under contract with its sub-companies to furnish them with American Bell instruments it is argued by some that the position is an embarrassing one for that company. On the other hand, it is not learned that the Mexican management feels disconcerted. A termination of the contract has been considered possible at any time. The company has three months in which to buy a supply of instruments under the present contract; it may make a new contract; it has had offers from the People's company to supply it with telephones manufactured in Mexico; it can buy instruments abroad and adopt, if necessary, one of several expedients, turning over Bell instruments in use by itself to subordinate companies and substituting telephones of other patterns, etc. The company has, besides, it is believed, the exclusive right to manufacture instruments in Mexico for a series of years.

The Boston *Advertiser* of the 25th says: The statement given a few days ago that the Mexican Telephone Company was embarrassed by the action of the American Bell Telephone Company, in giving notice of a termination of its contract in three months, is said to be incorrect. The fact is that of the nine sub-companies supplied by the Mexican Company only two of them have contracts requiring the American Bell instruments. Furthermore, a willingness has been expressed by the company from which the Mexican receives its instruments to renew the old contract on satisfactory terms to both companies.

Relief from Telegraphic Tyranny.

Further additions have been made to the store of information acquired by the U. S. Senate Committee on Post-offices and Post Roads, with regard to the telegraphs of the country. Last week the committee received from President A. W. Dimock, of the Bankers and Merchants' Telegraph Company, a communication, accompanied by a map, showing the extent of the company's lines. In this communication Mr. Dimock says: "We fully appreciate how disastrous it would be for the people and business of this country to be left subject to the tyrannical control of the Western Union Telegraph Company. If there was no rescue from monopoly except by the strong hand of government interference, then such interference would be justified in its origin and welcome in its results. But we respectfully claim that a telegraph system operated by the government ought not to be adopted except as a last resort, when it clearly appears that the people who are the sufferers from monopoly are unable of themselves to obtain relief. Such relief may be obtained by competing companies. Of such competing companies the Bankers and Merchants' Telegraph Company is the largest, and is from its very structure an anti-monopoly and popular corporation.

"It cannot be driven from the field by a war of rates. Its stock is wholly free from "water;" its property has been bought at fair prices and paid for in cash. By the excellence of its telegraphic service it has more than held its own against all its competitors. As an illustration, I will merely cite the fact that it transmits more of the dispatches sent between the New York and Philadelphia stock exchanges (a service demanding the highest efficiency) than all other telegraph companies combined. It was one of the very few companies whose operators remained in service during the whole of the great telgraphers' strike."

Mr. Dimock states that the company has in operation a pole mileage of nearly 5,000 miles and a wire mileage of more than 34,000 miles, and has under contract, now building, and to be completed within a very few months, a further wire mileage of over 30,000 miles. The map which accompanies the communication is designed to show that the lines of the company will soon reach from the great lakes to the Gulf of Mexico, and from the Atlantic to the Missouri River. Mr. Dimock states that the company has a favorable contract with a cable company for a cable to Europe; that 400 offices are now in operation; that it has a contract with the United Press Association for the transmission of its news dispatches; that it has has a controling interest in the United States Telephone Company and in the Commercial Telegram Company, under which stock and produce quotations are being distributed similarly with those furnished by the Gold and Stock Company, which is controlled by the Western Union.

In conclusion, President Dimock says: "We are ready to enter into a contract with the United States for the transmission of telegraphic dispatches over our lines upon very reasonable terms, and we believe that we can perform the service more efficiently and economically than it could be done by the government."

The Relations Between Garrett and Gould.

The statements made to the Senate Committee on Post Offices and Post Roads by President Norvin Green, of the Western Union Telegraph Company, have convinced Senator Van Wyck that the relations between that company and the Baltimore and Ohio Company are not as antagonistic as the latter corporation has endeavored to make it appear. Mr. Van Wyck is anxious for further information on the subject, and with that object in view he offered on the 27th February in the Senate a resolution instructing the Post Office Committee to inquire whether, at any time, the Western Union or the Baltimore and Ohio, or any of their officers or employés have entered into any contract or negotiation for the purpose of effecting a consolidation or a combination of any kind. A similar resolution was adopted at Mr. Van Wyck's suggestion some time ago, but the inquiry was limited to the past year.

Mr. Morgan intimated a doubt of the power of Congress to compel the companies to produce their contracts, and added that he did not understand what the Senate could do with the information after it was obtained.

Mr. Plumb declared that the controversy between the rival telegraph companies was nothing to the Senate. He wanted the committee to report on the postal telegraph system, and he did not believe the stringing of the thing out from week to week would do any good. Mr. Platt said he wished the government to assume control of the telegraph in some way as a means of conveying intelligence throughout the country, but he could see no benefit to be derived from the proposed inquiry. Mr. Platt added that he thought it very certain that any further telegraph consolidation, the effect of which would be to make the people pay more for dividends on watered stock, would hasten the time when the government would assume control of the telegraph. Mr. Platt moved to refer the resolution to the Post Office Committee, and after Messrs. Ingalls and Bayard had advocated that course the motion was adopted.

Underground Wires Discussed at Albany.

At the resumed hearing before the Senate Committee on Miscellaneous Corporations, at Albany, on Feb. 26, on Senator Daly's bill for placing wires under ground in New York and Brooklyn, Senator Daly strongly advocated the measure, replying to Burton N. Harrison's remarks at the last hearing, seeking to repel his assertions, and urging the necessity of the passing of the bill in compliance with the alleged public sentiment upon the subject. Mr. W. H. Eckert, General Manager of the Metropolitan Telegraph & Telephone Company, gave his views as to the impracticability of underground telephony in New York City. He was followed by Mr. W. D. Sargent, General Manager of the Brooklyn Telephone Company, who coincided with Mr. Eckert as to the necessity and advantages in some respects of having wires placed under ground, but denied the existence of any practical system for the operation of the same, stating the difficulties to be from induction and retardation. Mr. T. D. Lockwood, the electrician of the American Bell Telephone Company, of Boston, made a long statement, quoting largely from an English publication, to prove the induction and retardation theories. By an interesting experiment Mr. Lockwood demonstrated to the committee the cause and nature of induction between electric wires. These gentlemen protested that the question of expense did not inspire their opposition to placing the wires underground.

Mr. Robeson, representing the Standard Underground Cable Company, read a letter from Capt. F. V. Greene, representing the Commissioners of the District of Columbia, in which he says that the underground cable in use for some months past by the telephone and fire alarm service of Washington has shown the success of underground wires for combined telegraph and telephone service, claiming that the entire freedom from the usual buzzing sounds on the telephone lines shows its superiority over the aerial lines. Mr. Henry Van Hovenburg, the well-known electrician, in behalf of the underground system, enlightened the committee as to the working of subterranean lines in London, and in reply to the inquiries of the committee affirmed that it was entirely practicable to operate the entire electrical system of New York and Brooklyn by means of underground wires. Mr. W. J. McElroy, an electrician, followed in support of the underground system, giving the result of his experience in laying and operating subterranean wires. The committee adjourned to Tuesday next, when the telegraph companies will be heard.

Electrical Information for Beginners.

BY WM. MAVER, JR.

Introductory and Historical Sketch of Electricity and Magnetism.

The article entitled "The Elementary Study of Electricity," which recently apeared in the editorial columns of this journal, fairly outlined the object and mapped out the course of the following papers. A few words more of explanation, however, may not be amiss.

In the first place, I may state that I have no intention of offering any new theories regarding the phenomena of electricity and magnetism in the succeeding articles. I shall confine myself solely to the task of describing, so far as I am able, in plain language, and with the aid of illustrations and familiar analogies, such of the known laws and actions of magnetism and electricity as are calculated to be of the most practical value to the reader.

It will be assumed at the start that the reader is, in every sense of the word, as regards the study of electricity and magnetism, a beginner.

In common with other writers, I have found that no explanation can be made too simple, and no analogy too homely, when treating of such subjects.

At the same time I will strive to avoid leading the reader over a roundabout road of three or four miles if a short cut of half a mile will bring him to the same point.

An effort will be made in opening this subject to depart somewhat from the track so generally followed by writers on these topics, and while at first the method to be adopted may seem irrelevant to the main subject, I hope that its connection therewith and the reasons therefor will be observed later on.

I may also state that when in the progress of the opening chapters reference is made to any electrical, or magnetic action, law, or instruments, if not at once explained or described, it may be taken for granted that such explanation or description is only deferred until the proper time.

Where chemical actions are spoken of they will, as a rule, be stated as facts, which the reader can verify at his leisure.

It has been my experience as a student, confirmed by a comparatively limited experience as a writer, that it is always a good plan before proceeding with the description of any science, or any mechanical or electrical system, to give in a general way a summary of the history, theories, objects, and in fact any information connected with or analagous to the subject. The design of this is to make the subsequent descriptions more easy of comprehension, and thereby in a measure simplify matters, both for the writer and the reader.

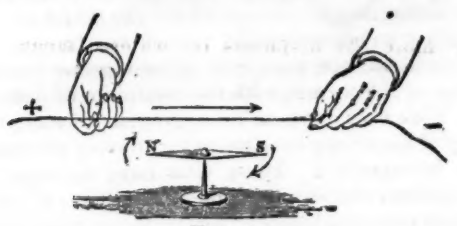

FIG. 1.

I shall, therefore, as far as practicable, endeavor to follow this idea in this case.

Electricity and magnetism have been so closely allied of late years, in so many different ways, that it has become generally understood that any reference to the science of electricity also includes that of magnetism, and the caption of this paper, viz., "Electrical Information for Beginners," is no exception to this rule.

Before the Christian era enlightened investigators were aware of a remarkable property of at least two mineral bodies, namely, amber and tourmaline, which was, that either of these bodies, more especially amber, after slight friction would acquire the power to attract light bodies which were placed within a certain distance of it.

The Greek word for amber is elektron, and from this word is derived the term electricity.

The ancients were also aware of the existence and of the peculiar properties of the magnet, or as it was more commonly called by them, siderites.

They were likewise familiar with some of the points of distinction between electrified and magnetized bodies. For instance, that the latter only attracted iron, but that its attraction was permanent; while electrified bodies attracted any kind of bodies, provided they were small enough and near enough; and that the power of attraction is transient. But up to the close of the sixteenth century electricity was unknown as a science. The only known source of electricity at that period was friction.

The lodestone, or natural magnet, was then the only source from which magnetism could be obtained.

In the year 1600 Dr. Gilbert, of England, made many experiments, and discovered, in addition to those already known, numerous substances capable of being electrified by friction.

Gilbert was also the first to apply the terms north and south poles to the different ends of a magnet.

Nearly two centuries more passed before any decided advance was made in electrical knowledge. In or about 1733, however, the existence of the two conditions of electricity, namely, negative and positive, was noted, and experiments, showing the different conductibilities of bodies were made. Bodies were thus divided into two classes, called conductors and non-conductors of electricity.

There were two theories in vogue regarding electricity about this time, one of which was known as the two fluids theory. This theory imagined "that the two powers were both owing to emanations of two particular elastic fluids, which, when mixed in due proportion, would counteract each other or would form a sort of neutral compound."

The other theory was known as the Franklinian, or one fluid theory. It supposed that all electrical phenomena are produced by an invisible and subtile fluid existing in all bodies, and that this fluid was also very elastic, and had a tendency to repulse its own particles, but to attract the particles of other matter.

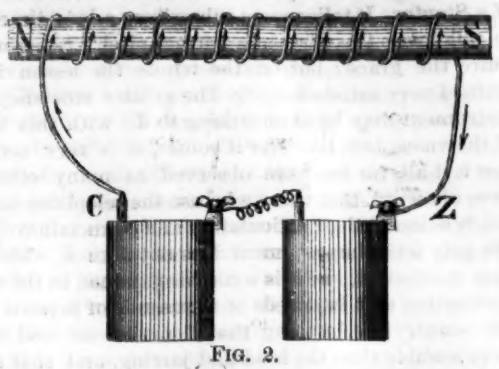

FIG. 2.

In 1790, Galvani, of Bologna, noticed the electrical action produced when two different metals were connected together by the muscles and nerves of a frog, or other animal.

He supposed that the muscles of the frog performed the same office as that of the glass, in the well-known Leyden jar.

In 1800, Alexander Volta showed, by a number of experiments, that the electricity produced as above was due to the contact of the two different metals. That when, for instance, zinc and copper are brought into contact, the copper becomes charged with positive, and the zinc with negative electricity. Volta supposed that the electrical action was due entirely to the actual contact of the two dissimilar metals, but it has since been claimed that the effect is really due to a chemical action, instituted in this case by the zinc plate.

Volta, in 1800, arranged a battery on this principle, for producing electricity, which has since been known as the voltaic pile. This arrangement consisted of a small circular piece of copper laid upon a piece of zinc of similar size and shape; a piece of paper, moistened with brine, was then placed on the copper, upon which another pair of zinc and copper circles, or discs, were placed; moistened paper was again inserted between these and another pair of discs, until a desired number of layers was obtained. When the lower disc of zinc was connected with the uppermost copper disc by a piece of wire or by the hands, a distinct shock was felt. Volta subsequently carried this discovery further, and made a battery on the same general principle, by immersing a plate of zinc and a plate of copper in a glass or cell containing an acid solution, with modifications of which we are now all so familiar. A pair of such cells is shown in Fig. 2.

Electricity thus generated was known for a long time as galvanic or voltaic electricity, but of late years the term voltaic has been generally adopted.

Electricity which is developed by friction is known as frictional electricity.

In 1802, Romagnesi, of Trente, discovered that a magnetic needle, or mariner's compass, was deflected from its normal position—that is, pointing north and south, by the presence of a current of electricity in a wire held parallel to the needle, as shown in Fig. 1.

It remained, however, for Prof. Oersted, of Copenhagen, to discover that the deflection of the needle in a particular direction was governed by the direction of the current flowing through the wire, as we shall see later on.

The needle telegraph systems subsequently invented, the needles of which, by prearranged movements to the right or left, indicated certain letters, were based on this discovery, and it is a fact that the successful working of the Atlantic cables is owing, in a great measure, to a skillfully arranged and exceedingly sensitive adaptation of this same law, which arrangement was the invention of Sir W. Thompson. Briefly, it consists of a very delicate magnetic needle suspended within a coil of wire. A ray of light thrown on the needle causes it to cast a shadow on a screen. A very slight current of electricity passing through this coil of wire is sufficient to cause a deflection of the needle to the right or left according to the direction of the current. As the smallest motion of the needle is shown on the screen in a greatly magnified form, these signals can thus be easily read by the operator.

This same law is also taken advantage of in the construction of the galvanometer, an instrument which indicates the presence of a current of electricity in a wire by a deflection of a magnetic needle. The strength of the current of electricity is also measured by this instrument, as the extent of the deflection of the needle to the right or left is according to the strength of the current passing over it or near it.

As before stated, however, I am at present merely making passing reference to these laws and instruments.

In 1820, M. Arago discovered that electricity possessed the power of developing magnetism in iron or steel to a marked degree.

In 1825, Spurgeon, of England, availed himself of this discovery, and made a magnet by winding a wire around a bar of soft iron, and causing a current of electricity to pass through the wire, as shown in Fig. 2. Magnetism thus derived is termed electro-magnetism.

The applications of this discovery to telegraphic purposes, in the ordinary U-shaped magnets, and in hundreds of different ways, at the present day, are well known.

A few years later, viz., 1831, Faraday, in the course of his electrical and magnetic researches, made the famous discovery that an electric current could be produced in a coil of wire by causing the coil to cut the lines of force of a magnet, in other words, by causing the coil to approach or recede from the pole of a magnet, for example, as seen in Fig. 3. In this experiment the wire connecting with the coil shown in the figure is led through the coil of a galvanometer (not shown). The deflection of the magnetic needle of that instrument manifests the generation of electricity as stated.

Electricity thus developed is called magneto electricity.

Dynamo-electric machines are based upon this discovery.

These discoveries bring us up to the present period, for nothing especially new has of late been discovered with relation to these forms of energy.

The inventions consequent upon these discoveries have been numberless.

The theories with regard to electricity and magnetism have somewhat changed, however, and now the most generally accepted theory concerning electricity is briefly that it is a peculiar force, which causes the particles of a body or substance to change their positions with respect to each other.

A theory of magnetism which seems to explain a number of conditions, is, that in a magnet each atom or particle of the mineral is a magnet, and that the magnet, as a whole, is caused by the particles being so turned as to all point one way. Another theory of magnetism, known as Ampère's theory, is that in every magnet there are currents of electricity circulating around a magnet, at right angles to a line drawn from pole to pole of a magnet. For example, these currents, by Ampère's theory, are supposed to circulate around a magnet in the direction shown by the arrows in Fig. 2. We can see that if a line were drawn from *N* to *S* in this figure the arrows would be rotating around the line. In addition to these theories others have been advanced, not only as to the nature of electricity and magnetism apart, but also as to their connection with each other; for the discoveries just referred to, namely, that electricity could be produced in a wire by the means above described, and that magnetism could be induced in iron by the presence of electricity in motion, naturally set philosophers thinking that since these forces were mutually convertible, the one into the other, they must be in some way related to each other, and while to this day the exact nature of this relationship is a mystery, subsequent investigation but confirms the theory that a mutual relationship, or, as it is termed, a correlationship, exists between them. Indeed, since the great discovery of the conservation of force, or energy, (or in other words, that force is not destroyed, but that when it disappears, it does so only to appear in another form of force or energy), and the kindred discovery of the correlation of all forms of force or energy, which discovery or theory was first fully brought out by Grove, of England, in 1842; philosophers now go further, and argue as Grove did at the time referred to, that as we know that electricity and magnetism are forms of energy, they, according to the above theory, must be correlated to heat, light, chemical action, and all other forms of energy.

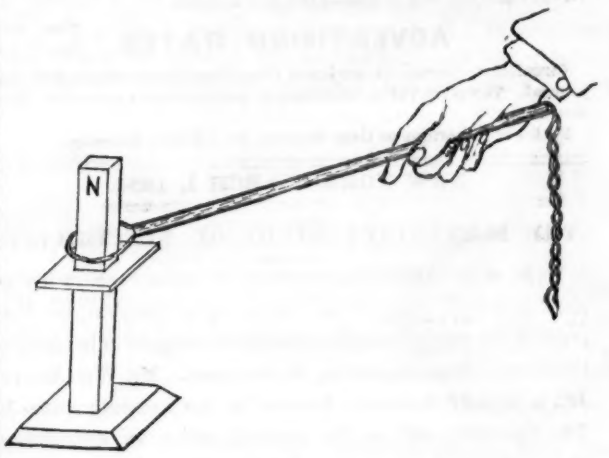

FIG. 3.

But how do we know that electricity and magnetism are forms of energy?

We have seen that both magnetism and electricity have the power of moving certain bodies by attraction, and we shall also see that they can do so by repulsion. As it is an undisputed fact that no body, however small, can move of itself, a certain amount of force or energy must be expended in moving it. Therefore there can be no doubt that electricity and magnetism are forms of energy. This being the case, it will perhaps be well to devote some time to the study of the nature of energy, as well as to the theories relative to the correlation of all forms of energy, and the conservation of energy.

[TO BE CONTINUED.]

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NEW YORK, MARCH 1, 1884.

THE ELEMENTARY STUDY OF ELECTRICITY.

It is with much pleasure that, in accordance with an announcement made at the beginning of the year, we now publish the articles on electrical information for beginners, the first of them appearing in this issue. Mr. Wm. Maver, Jr., is already favorably known by his special articles in *The Operator*, and in the present series on elementary electricity and magnetism he treats his subject in a way that will, we believe, not only instruct beginners, but prove attractive to many who have advanced far beyond first principles.

SOME INDIRECT BENEFITS OF TELEPHONY.

From time to time there has been a great deal of discussion in the papers as to the supposed injurious effect of the use of the telephone on the voice and on the sense of hearing. In spite of all the alarming stories told, evidence of a clear and positive nature is still lacking, however, to the establishment of the fact that any harm is done; on the contrary, it may be safely affirmed that in more than one particular, daily intercourse by means of the telephone has benefitted the senses exerted in its use, making them more acute, nimble and accurate. This is what might be expected. Telegraphy as practised to-day makes operators unusually quick of hearing and sensitive of touch. Pianoforte playing renders the wrists and fingers peculiarly flexible. A bank teller or a restaurant cashier knows bad notes and coin almost at a glance. It would be strange if, in the same way, as the result of habit and of fixing the attention in one direction, telephonists did not find their senses improved.

We think that among exchange operators and those who use the telephone frequently, hearing is rendered much keener. Some day in the future, when the telephone magnifies sound like the speaking trumpet, good ears will not be required for it; but at present they are indispensable. Probably there are many telephone subscribers who believe that Professor Bell has successfully used his influence to get the exchanges filled up with deaf persons for experimental purposes, but impartial men of average patience and good temper will admit that their "calls" are answered promptly. We have noticed that the operators and the subscribers alike are quicker of hearing than the ordinary run of people. Their ears undergo a kind of training and discipline, and just as the proof-reader straightens out a jumble of type in an instant, or a reader of "blind letters" in the post office sees what is the address in the badly written superscription, so the operator at the switch-board soon learns to catch the faintest or most confused sound and to interpret it. The subscriber, too, becomes the possessor of a cultivated ear, and we have often remarked the ease with which a business man accustomed to the telephone will substitute himself at it for another man who is not so expert and alert of ear and wants help in carrying on the conversation.

This applies also to the act of speech. The world is gradually coming to the knowledge that in order to be heard over a telephone line a man need not be a roaring bull of Bashan, and that the still, small voice will travel the longest distance just as well as the thundering tones of a Stentor. It takes some subscribers a long time to learn to talk over the wires at a normal pitch; many never acquire the grace; but on the whole the lesson is being learned very satisfactorily. The greater efficiency of the instrument may have something to do with this lowering of the voice, but, however it comes, it is very acceptable. Nor is it all, for we have observed, as many others must have observed, that those who use the telephone have very much bettered their articulation and enunciation of words. The pity is the improvement does not take a wider range than is afforded, but it is something gained in the cause of civilization that hundreds of thousands of persons all over the country are learning that tones sweet and low are more audible than the loud and jarring, and that it is desirable to speak clearly.

Aside from these physical effects, there is a mental benefit derivable. All writers upon mental philosophy insist, with perfect propriety, on the value of the habit of attention. It is pre-eminently important and valuable, its absence being an insuperable obstacle to great intellectual attainment. Now, the telephone is peremptory in its demand for attention. The operator must be heedful and thoughtful, and the subscriber must, while connected, be all ears and memory, even where the reply is taken down as received. The mind cannot wander from the subject immediately before it, and thus gains more power of concentration and retention.

THE ACTUAL COST OF TELEGRAPH LINES.

The investigation of the telegraph companies by the sub-committee of the U. S. Senate Committee on Post Offices and Post Roads has dragged its weary length along another week. The effort to draw out specific information from Dr. Norvin Green with regard to contracts and leases made by the Western Union Company did not result in anything very startling. One point is noteworthy as showing how stock can be watered. He admitted that the stock and bonds of the American Union Company had been bought by his Company for $15,000,000. Now, Mr. Robert Garrett stated that he knew from his connection with the American Union that its lines cost $4,000,000 to build. But Mr. Van Horne, Vice-President of the Western Union Company, is credited with the statement that none of the competing companies absorbed by the Western Union had ever paid expenses. Thus it appears that $15,000,000 was given for lines that cost only $4,000,000 and that did not earn expenses, the said $15,000,000 being Western Union stock on which the public has helped to pay a good round dividend.

As to the question of press dispatches, Dr. Green said an attempt had been made last November to raise rates to certain newspapers because they did not patronize the Western Union exclusively. He had, however, reversed the action in this respect, and published an order that all newspapers should be entitled to the special rates and treated alike. There had been provisions in the Press Association contracts that they should use the Western Union lines whenever the lines were in condition, but this had not prevented the *Herald* or *Times* or *Sun* from taking messages from other lines. There was a feature in the contract that they should not be entitled to the reduced rates—that is, the rates for special service—unless they did patronize the Western Union exclusively, or substantially so, but that had been abolished by a general order, and all newspapers were now entitled to the same rates for special reports. This would tend to show that the company no longer considers itself absolute, for it is hard to believe that the order would be withdrawn out of mere good feeling. It appears, too, from Dr. Green's evidence that the number of free messages sent last year was 1,689,306, of which seven-eighths were railroad messages. "The only absolutely free franks were those given to prominent officers of the railroads, and those franks cover only family and personal messages. The railroad business was not a free service. A valuable consideration was received." If we remember aright, among the effects of the late restaurateur, Mr. Delmonico, dropped by him in his wanderings about New Jersey, was a book of Western Union franks, but he was not known before to be a railroad magnate.

Taken as a whole, the evidence does not reflect much credit on the Western Union Company, and the public is not slow to assume that the half left untold of the story is of the same nature. But it is clear that there is abundant competition in the telegraph business just now. Senator Hill thinks that the antagonism between the Baltimore & Ohio and Western Union companies is but temporary. "It would," he said, "be in entire keeping with the practice in the past if they were working together to-day; they might be as far apart as the poles to-day and be together next week." But they are not the only competitors, and the present activity of the telegraph companies is a state of things that it would be most injudicious to disturb by legislation directed toward the establishment of a governmental monopoly.

ELECTRICITY FOR THE ELEVATED RAILROADS.

It was remarked by the late Count Du Moncel, in his work on "Electricity as a Motive Power," that the application which should pay best, and that perhaps in which its use approaches nearest to perfection, is the locomotion of vehicles, the main economic reason being that in utilizing electricity the production of the force takes place at a distance instead of on the vehicle that is moved, and that the motive power is thus reduced to the little motor fitted to the carriage. There are now on record many experiments which have been successful, and as we said last July, in reference to the electric railway at the Chicago Exposition: "That electricity is to be the tireless steed of the future no one doubts. When an idea has become so much of a fact as the electric railway, its final perfection is near at hand." To look at the results obtained at Lichterfelde, Berlin, Paris, Brussels, Portrush, Chicago, Saratoga and other places, is only to confirm the conviction that the practical application of electricity on a large scale to railroad operation is already within a measurable distance.

All New Yorkers, and even those who detest monopolies, admit that the system of elevated railroads is a great boon to the city and its toiling population. It has done more for New York in five years than the horse cars could have done in twenty-five. But the valid objection to it is that as at present operated by means of steam locomotives, it renders the life of thousands who occupy houses and stores along the track almost unendurable, and frequently makes travel a misery. The locomotives are dirty, noisy and smoky. Steam, oil and cinders continually drop on the pedestrians beneath, and if the windows or doors of the car are left open, the passengers are smothered with countless flakes of the hard coal used.

A remedy for this is wanted, and if we judge by the wretched mishaps on the Brooklyn Bridge, it is not to be found in endless cables. Electric propulsion offers its services next, and here, in our opinion, will the choice of the companies rest. In the *Tribune* of this week appeared a very interesting letter on the subject, from Mr. T. W. Rae, C. E. His communication, though long, is terse in its statement of what are understood to be the facts of the case. We cannot do better than to give, as we do elsewhere, his estimates in his own words. Taking the most exacting conditions of service to be rendered on the total thirty-two miles of track, he gets an hourly expense for motive power from steam locomotives of $174.56, while the same work done by dynamos and electric tractors would cost $76.56. That is, it now costs $2.28 to do by steam that which electricity can do for $1.

It must be borne in mind that, as the track is elevated, the conditions are thus very advantageous for the transmission of the current with the minimum of loss. Should New York ever have an underground railway, the superiority of electricity over steam for traction purposes would again be manifest. Those who have traveled on the Metropolitan Railway in London complain of the manner in which the air is poisoned by the locomotives in use, and it is said that in summer or winter the atmosphere of that subterranean road is suffocating. With electricity, however, no impurities would be given off in gas or smoke or soot, and all the speed desired would be obtainable. It will be noted that the estimate does not take into consideration the saving on the wear of the road bed, and the lessened vibration of the supports.

SO FAR AND YET SO NEAR.

Electricity has been put to so many novel uses of late, that no one was surprised to learn that it had been successfully employed for hatching eggs and for ripening liquors; but it remained for Pennsylvania to show us what benefits might be derived from the telephone by separated lovers. The ardent Gentile suitor John Farr, of Scranton, and the beauteous, blushing Jewess, Miss Levy, having formed an attachment for each other, were forbidden by the maiden's family to meet or correspond, and so severe did the surveillance become that the girl was not permitted to leave the house except under duenna guard. Yet she seemed perfectly satisfied with this arrangement, and it was only after she and Farr had eloped and married that her family discovered that the lovers had been spending hours and hours every day cooing to each other over a telephone line between the offices in which they worked, and that by that means they had planned all in secret.

Modern prosaicism has discarded the old, stately, romantic salutes: "What, ho! my lord!" "What ho, without," for the 'phones business-like: "Hello! Hello!" but this incident shows that even with these curt, practical preliminaries, the most loving conversation can be carried on over the wires of the telepbone. The fact is established that the captive maiden, if she has the use of the little instrument at her father's house, can converse with her interdicted lover, who is safe from the paternal boot, far and away "over the garden wall." The serenading troubadour can now thrum his throbbing guitar before the transmitter undisturbed by apprehensions of shot guns and bull dogs. Romeo need no longer catch cold waiting at Juliet's balcony, nor need Leander encounter the perils of the waves in seeking his Hero. But the new means of communication has its disadvantages, and must be used with caution. There will be the danger of a wrong "connection" at the Exchange, and there will be no letters to produce as evidence in a breach-of-promise action.

Steam Engines for Driving Dynamo-Electric Machines.

III.

THE BALL AUTOMATIC CUT-OFF ENGINE.

(Concluded.)

In this engine, as in the two forms already described, a single valve performs the function of admitting and of exhausting the steam at either end of the cylinder, the point of cut-off being likewise determined by the range or

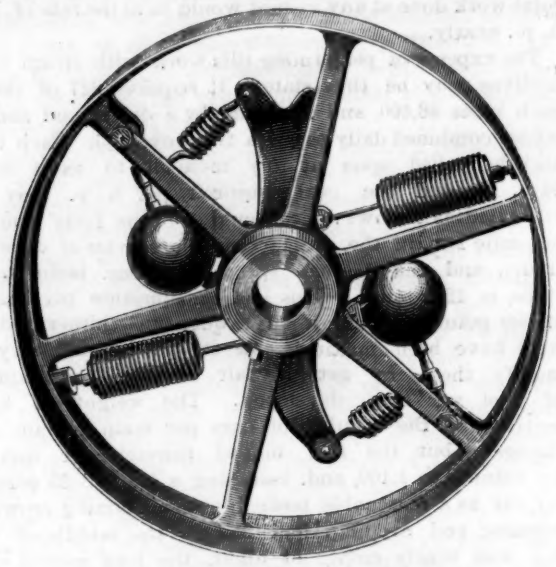

FIG. 3.—**THE BALL GOVERNOR.**

"throw" of the valve, which, as we have seen, is controlled by a variable eccentric. Engines of this class, which includes nearly all high-speed automatic cut-off engines, are called "single-valve automatic" to distinguish them from those types of engines—like the Corliss engine, for instance—in which there are valves for admitting the steam into the cylinder and valves for exhausting it. The single-valve is eminently applicable in the high-speed engine, not merely because it lessens complication, but precisely because of the manner in which it supplies the steam to the cylinder when controlled as above. It permits that coincident, inverse relation between expansion at the steam side, and compression at the exhaust side, which is the safeguard necessary for reciprocating parts moving at such speed, and which is an important factor of quick regulation of speed under variations of load. However, a little thought shows that although a single-valve automatic cut-off is well adapted to the high-speed engine, its fullest advantages

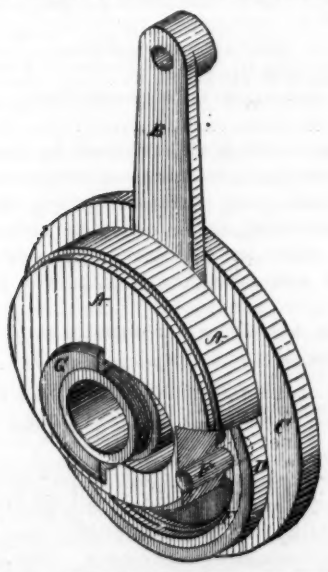

FIG. 4.—**THE BALL ECCENTRIC.**

cannot be realized with the centrifugal governor, so far as precision of regulation is concerned, unless the valve itself answers certain requirements.

In the Corliss engine, the valves all receive their motion from an eccentric which is not variable, so that its lead and throw remain the same; the function of the centrifugal governor is merely to determine the point of cut-off, which it does by adjusting a "trip" that detaches the steam valve, and allows it to be closed. In the high speed engines, where the centrifugal governor acts upon the eccentric from which the valve receives its motion, every change in the position of the fly weights must move the valve itself a little so as to change its throw. It is evident therefore that where quick, accurate regulation is desirable, as in this case, the valve should work with ease in its seat, instead of being held tight in it by steam pressure. In a word, the valve should be *balanced*, as was done in the first two engines described. This seems to be a necessary condition of close regulation with single-valve automatic engines regulated by the centrifugal governor. With the dynamometric governor of the Ball engine, however, this condition is not essential. Any kind of valve may be used, and Mr. Ball has avowed his preference for unbalanced valves by adopting one in his engine.

There is a difference of opinion among engineers on the question of "balancing" valves. A valve that is accurately balanced by allowing the steam to press upon it equally on all sides is certainly less subject to wearing in its seat, while it requires much less power to drive it. However, it is urged against balanced valves that they are more likely to leak, for wear must take place sooner or later in the valve seat; while in the case of unbalanced valves, the very pressure which wedges or binds the valve against its seat is enough to insure a perfectly tight fit which takes up wear. The wear of an unbalanced valve is apt to be very great, however, and for this reason it is desirable that such valves should be only partially unbalanced, leaving sufficient pressure to maintain the valve to a bearing that is steam tight. This is the case with the valve of the Ball engine.

This valve is of the "slide" pattern, though it might be more aptly compared to a "drawer" of a desk. It presents the appearance of a ring placed between two flat pieces which form its wearing surfaces. It is disposed horizontally in the steam chest and slides like a drawer between two cheek pieces which form its seat. In the centre of the upper cheek piece is the opening through which the steam is conveyed from the steam pipe into the inside of the ring portion of the valve. At either end of both the upper and lower cheek pieces are the ports for admitting the steam into the cylinder. There are consequently four ports, two at each end, those in the upper cheek being directly above those in the lower cheek piece.

Now as soon as the valve has moved toward one end sufficiently, the ports in the valve itself uncover these two ports simultaneously, and steam is received into them from the hollow ring portion of the slide valve. The openings from these two ports converge toward a common opening which admits the steam into the cylinder. In this situation the two ports at the other end are entirely uncovered by the steam valve, and the steam from that end of the cylinder can exhaust *into the steam chest*, at the bottom of which, at either end and near the ports, is a pocket or depression which leads to the exhaust pipe. When the valve travels back in the opposite direction the ports which just exhausted begin to admit steam, while the others in turn exhaust into the steam chest. This disposition is not only favorable to quick admission and quick exhaust by the double ports which it gives, but it presents an immense advantage in the fact that it allows of the inspection of the steam valve *while it is in operation*. The cover of the steam chest may be removed while the engine is running and the valve examined, the exhaust steam being permitted to escape into the engine room. Any leakage or imperfect working can thus be readily detected.

The manner in which the motion of the valve is obtained and varied is what remains to be analyzed. Fig. 3 shows the governor pulley, which as previously stated is also the driving pulley. Pivoted to the pulley at diametrically opposite sides, near the circumference, are two short arms, to the free ends of which balls or weights are attached, the weights being therefore free to swing.

The pulley is set loosely on an inner hub, which is itself keyed to the crank shaft, so that the result is practically the same as if the pulley worked loosely on the shaft. This inner hub is provided with two radial arms, at the outer end of each of which is attached a short, strong, helical spring. When the engine starts, the crank shaft turns in the direction of the hands of a watch, and with it the radial arms. Now supposing the pulley to be belted to a "load," the springs just mentioned are pulled and tend to swing the weights in a centripetal direction. But these weights are already pulled inward to their fullest extent by strong springs extending from the weights themselves to the rim of the pulley. Consequently the effort communicated to the crank shaft and to the radial arms causes the springs at their outer ends to stretch to an extent commensurate with the load on the pulley. The relative motion which takes place at the same time between the pulley and these arms is utilized in causing an increased throw of the eccentric. But the fly weights themselves have the power of regulating the throw of the valve, because they are connected to the eccentric by an arm, which can just be seen in the figure, at the inner side of the left weight. When the engine is started both causes act in combination to increase the throw; but when the engine has attained its normal speed the fly balls, by their centrifugal motion act upon the eccentric so as to decrease its throw; at the same time that they do this, they pull on the springs which connect to the radial arms and move them back. It is true that the distension of these springs, being due to the load, remains unchanged, but the point of attachment of each spring to the pulley becomes practically moved back in consequence of the leverage which is exerted upon it by the arm to which each weight is attached. The rela-

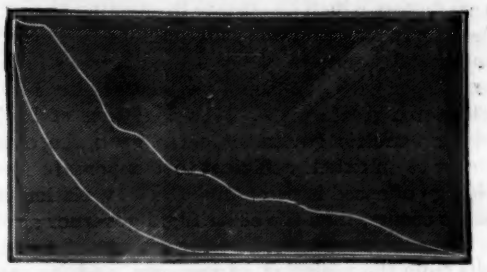

FIG. 7.

tive displacement between the pulley and the arms is therefore diminished, and in consequence the throw of the valve as due to this displacement is also diminished.

The arrangement of the eccentric and the manner in which the relative displacement due to the radial arms and the fly weights is made to effect the variation of eccentricity which varies the throw, will be understood by reference to Fig. 4, which represents the eccentric as it appears when the pulley (Fig. 3.) is examined from the other side. The main eccentric *A A*, shown partially broken, to expose the other parts, is attached to an arm *B*, the outer end of which is pivoted to the extremity of one of the radial arms above described (the upper arm in Fig. 3).

This eccentric does not touch the shaft, its shaft-opening being large and oblong, so that the eccentric itself can swing like a pendulum across the shaft. The further it is swung the greater the eccentricity and the greater the throw. Between the eccentric and the pulley is a disc *C* which moves loosely on the shaft, being provided with a sleeve or hub, which surrounds the shaft and passes through the shaft-opening in the eccentric, a flange nut *G* on its end serving to retain the disc *C* against the eccentric *A A*. On the inner surface of the disc *C* is a circular flange *D*, which is disposed eccentrically with respect to the shaft. The result is the same as if a ring were fastened to the disc eccentrically. Inside of this is another flange *F*, which is not clearly shown in the figure. Between these two flanges there remains an eccentric groove, and a stud *F*, passing through the eccentric *A A* projects into this groove. It is now easy to understand how the eccentricity of the eccentric *A A* becomes varied. The fly-weights are connected by arms to the disc *C*, and their centrifugal motion would rotate the disc to the right. At the time of starting the engine, however, they are as far inward as possible, and the disc is practically stationary with respect to the *pulley*. But the radial

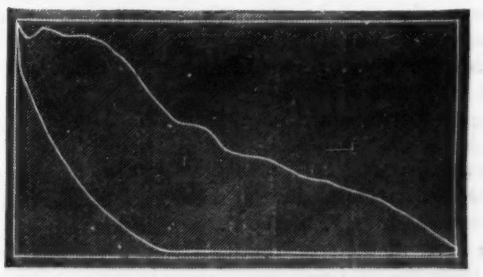

FIG. 8.

arms move, distending the springs, and this motion causes the arm *B* to turn toward the left relatively to the pulley and disc. The eccentric *A A*, to which it is attached, therefore moves toward the left. The stud *F* now slides in the eccentric groove, and, as will be readily understood from the figure, the eccentric is thereby made to swing across the shaft toward the left with the effect of increasing its eccentricity. Now, as the speed increases to its normal limit, the fly balls swing out centrifugally, and thereby cause the disc *C* to turn also toward the left, as just stated, the effect of this movement being evidently the same, so far as the eccentric is concerned, as if the arm *B* itself had moved back. The outward motion of the fly-weights does in fact move the arm *B* back slightly beside moving the disc *C* forward, as we showed above. The result of this relative motion between the disc and the eccentric is to reduce the throw of the valve. An

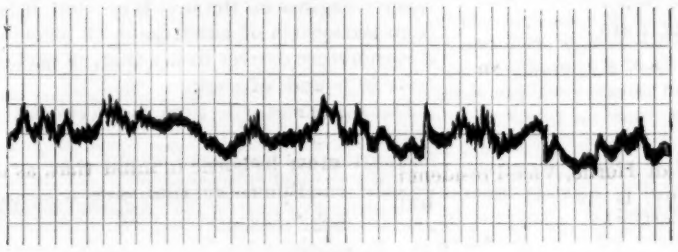

FIG. 5.

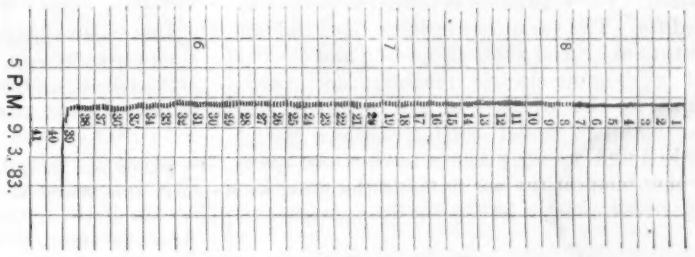

FIG. 6.

increase of load causes the load springs to stretch with the effect of allowing the arm *B* to move the eccentric with relation to the disc, and thus increase the throw. The increase of throw of the valve resulting directly from the motion of this arm, however, is very slight, but the necessary result is attained nevertheless, for by the increased pull on the load-springs the fly weights, to whose arms they are attached, are pulled inward, causing the disc *C* to move so as to increase the throw to the desired extent. Since the radial arms move with the crank-shaft, the pendulum-like motion of the eccentric, as the throw is increased, cannot materially affect the lead of the valve. It is seen that there are two factors which co-operate in effecting the regulation of the supply of steam, viz: a dynamometric governor and a centrifugal governor. They are so disposed as to be able to react upon each other, and yet each retains its freedom of action to a great extent. If a variation of load occurs the dynamometric governor reacts upon the centrifugal governor to an extent sufficient to compensate for it, and no change of speed is perceptible. If a variation of *steam pressure* occurs, then the centrifugal governor acts as if it were alone; it is influenced by the change of speed which results from the variation of pressure, and its change of position at once brings about a change in the throw of the valve, so that the steam is cut off sooner, or later, to compensate for it. If the load and the steam pressure are both varied at the same time then both parts, dynamometric and centrifugal of the governor, are influenced together and act to readjust the steam supply at once. The result is a quick and accurate regulation, which is a most substantial endorsement of the new departure in regulating methods which this engine presents. Fig. 5 is a speed diagram, showing variations of speed in a 250 horse-power engine with automatic cut-off, furnishing power to a paper mill. This diagram was made by a "Moscrop speed recorder," and each revolution was recorded as a short vertical line, whose position on the paper was higher as the speed rose and lower as it fell. The regulation shown by this record is said to be of good average character. Fig. 6 shows another speed diagram made by a Moscrop indicator from a Ball engine subjected to equally trying conditions. In this case the speed-line is remarkably straight and uniform, evincing the perfection with which the governor effected regulation. The regulation is indeed as perfect as could be wished for. The variations in these cases did not probably constitute as crucial a test as opening and closing the circuit of a dynamo-electric machine, by which fluctuations equal to the whole load are produced. A speed diagram obtained under such conditions would be very interesting, and would perhaps answer the question whether this new method of regulation encroaches upon the two per cent. margin left by the other method of regulation.

The possibility of maintaining the speed of an engine perfectly *constant*, in spite of variations of load and steam pressure, is not the only one which this new method promises. It leads to a new, hitherto impossible, result, which will probably be of much utility, namely, the speed may be made to *increase* or *decrease* with the load. This result may be easily attained by adjusting the tension of the load springs. In places where the work is intermittent this new resource of regulation would be useful. In a saw-mill, for instance, the speed could be made to increase while the saw is cutting, and to diminish when the load is removed. It is claimed that this mode of regulation would be useful in electric lighting, the engine being adjusted to give standard speed when driving full load, and so as to reduce speed as the lights are turned off. But we fail to see the advantages claimed. In lighting by incandescence, using shunt-wound or compound dynamos, a reduction of electromotive force would follow each reduction of speed. This is of course undesirable when the last lights to be turned off are required to burn as brightly as the first. In arc lighting, on the other hand, the effect of cutting out a light is to increase the load, because so much less resistance is excluded from the circuit. With the mode of regulation proposed the result would be an increase of speed instead of a decrease. As for regulating so as to increase the speed as the load decreases it is not to be thought of. On the whole the best procedure is to let the speed remain constant and to provide for regulation by electrical or other methods.

The new method of regulation does not present any risks from the engine running away in consequence of the springs breaking. The breaking of a spring causes the speed to be diminished, and if all the springs break the engine slows down and stops. The load springs may be looked upon as being more subject to breakage from the fact that they transmit the power or "carry the load" of the engine, but this load is not over 500 pounds for each spring in a 50 horse-power engine run at 300 revolutions, and with due care in the selection of the material and in the construction their durability should be almost unlimited.

The Ball automatic cut-off engine is made in three sizes, ranging in power from 20 to 60 horse-power, the sizes of cylinder being respectively 7 × 10, 9 × 12 and 10 × 12, and the range of speeds to which they are adapted being from 350 to 250 revolutions. These sizes are all very convenient for driving electric light dynamo-electric machines and probably have been designed for this special use. It is somewhat of a disadvantage, however, that both pulleys cannot be utilized in driving dynamo-electric machines, for in many instances an engine of a little larger size and capable of being belted direct to two dynamo-electric machines is of great convenience and might have the preference.

The indicator cards obtained from this engine are of the same character, peculiar to single-valve automatics. We have had one of these engines indicated for the purpose of publishing diagrams, by Mr. E. McGovern, M. E., of the New York Steam Heating Company, and also by Mr. H. VanAtta, M. E., of the Phœnix Electrical Co., who is using this engine (9 × 12 cylinder) for driving dynamo-electric machines in this city, and who, we must state, feels well satisfied with its performance. As the conditions under which these diagrams were taken were not favorable, however, for many reasons, not the fault of the engine, we are not satisfied to publish them. The cards we give herewith have been obtained from the makers of the engine. They were taken from a 9 × 12 engine running

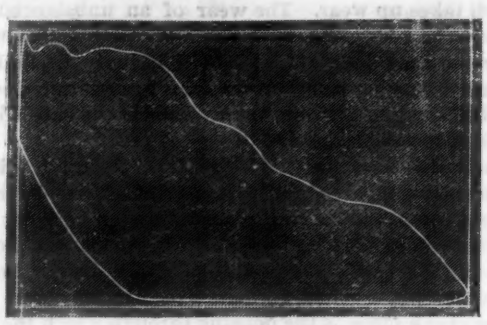

FIG. 9.

at 300 revolutions, with different loads, the scale of diagram being 60. The data of the diagram in Fig. 7 are as follows:

Boiler pressure, 80 lbs.
Mean effective pressure, 19.08 lbs.
Indicated horse-power. 21.75.
Net power on brake, 20.
Friction of engine, 8 per cent.
Theoretic water consumption, 24.75 lbs.

The data of the diagram shown in Fig. 8 are:

Boiler pressure, 76 lbs.
Mean effective pressure, 27.40 lbs.
Indicated horse-power, 31.23.
Net power on brake, 30.
Friction of engine, 7 per cent.
Theoretic water consumption, 23.90 lbs.

The data of the next diagram (Fig. 9) are:

Boiler pressure, 87 lbs.
Mean effective pressure, 47.61 lbs.
Indicated horse power, 54.27.
Net power on brake, 50.
Friction of engine, 8 per cent.
Theoretic water consumption, 24. 21.

These cards will compare favorably with those obtained from many single valve automatics. The steam line, however, is somewhat wavy though the oscillation of the indicator spring may be partly responsible for this unevenness. The cut-off is not so well defined as we find it in the detachable valve automatics and even as it is found in some of the single valve automatics, some of which challenge admiration in this respect. The expansion line is very nearly perfect, and the exhaust and compression lines are both excellent.

In conclusion we wish to thank Mr. W. M. Allaire, M. E., New York Agent of the Ball Engine Company, and Mr. Van Atta, for facilities kindly placed at our disposal in preparing this article.

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Electrical Propulsion in New York.

The subjoined is an extract from the letter of Mr. T. W. Rae, C. E., to the *Tribune*, giving an estimate of the cost of equipping the elevated railroads of this city for electric propulsion: The elevated railway system of New York city comprises—inclusive of sidings, etc.—thirty-two miles of track. Upon this road-bed are, or may be, running simultaneously 150 locomotives, each weighing, with its coal, water and personnel, 44,800 pounds, and drawing, at a speed of 13.25 miles per hour, three cars, each weighing, with its seated load of forty-eight persons and the gateman, 34,230 pounds. Summing up, it amounts to a total weight of 22,123,500 pounds, moved 1,166 feet per minute. Taking the commonly accepted coefficient for resistance to traction in rapport of weight moved, under average conditions of rolling gear and road-bed, to be .004 (vide Clark, Holley, Molesworth, Haswell *et al.*), the total work performed by the locomotives in any one minute is 3,127 h. p. nearly.

It is unnecessary to consider grade or curvature in applying the coefficient of tractive resistance, since of the total number of trains running to and fro, as many will be assisted as retarded by the former; and there being but 12 curves which change direction as much as 90° on all the routes, only 24 of the 150 trains in simultaneous motion could by any possibility, be passing them at the same instant, and this would not materially affect the total resistance of traction. Further, the influence of curves on the elevated railways is minimized by the admirable method of coupling trains, and it may be added that electric propulsion readily admits of fitting a motor to each car and manipulating them all from one, which would almost entirely neutralize curve resistance.

To make sure that the estimate shall include the most adverse conditions possible, the cars may be considered as crowded to their utmost capacity, or carrying say 100 persons each, and encountering strong side winds. In such a case the coefficient of traction might rise to .006 and the total work done at any instant would be at the rate of .5444 h. p., nearly.

The expense of performing this work with steam locomotives may be thus stated: It requires 227 of them; each costs $6,500, and is served by a driver and stoker, whose combined daily pay is a trifle over $5. Each may also be called upon at any moment to exert some 36 h. p., and the coal required per h. p. may be estimated as follows: Each engine burns forty pounds per mile run, in the ordinary routine service of drawing trains, and the average speed per hour, inclusive of stops, is 12.5 miles. This is a consumption per engine of 500 pounds per hour. The quantities hitherto dealt with have been maxima, and it will be necessary to modify them to get a fair average consumption of fuel per h. p. developed. The weight of locomotive and the number of cars per train remain unchanged, but the feet moved through per minute are reduced to 1,100, and, assuming a load of 25 persons per car as a reasonable mean between running crowded morning and evening, half full in the middle of the day, and nearly empty at night, the load moved may be taken at 136,690 pounds. Applying the general coefficient of traction, .004, this becomes 547 pounds moved 1,100 feet per minute, or 18 h. p., at a cost of nearly 28 pounds of coal per h. p. per hour. Of course, it is almost impossible that each engine should burn this quantity for each actual h. p. of work it performs. The warming of trains is included in it, and the average is no doubt vastly increased by the number of reserve engines which must be kept standing with banked fires ready for immediate service. The cause is not any unusual inefficiency of particular locomotives—although at best they are four times more wasteful performers of work than large stationary engines of the best type—but it is one inseparable from the system of subdivision of locomotive power, and it is therefore correct to say that, in such a system, a h. p. costs 28 pounds of coal.

The statement will then be, taking an hour as the unit of time:

Interest upon and depreciation of 227 locomotives @ $6,500, at the rate of 15 per cent. per annum	$25.26
Wages of attendants for 227 locomotives	47.30
Total coal @ $3 per ton for 150 locomotives, developing 18 h. p. each @ 28 lbs. per h. p.	102.00
Total per hour	$174.56

To do the same work electrically would require the following-named equipment:

It is quite possible to obtain dynamos which will return at any ordinary distance 75 cents of a h. p. developed by steam engines at the generating station, and this can readily be had for 2 pounds of coal per hour from large improved constructions. But assuming 50 cents, or thereabout, to be the ultimate and a duplicate installation to be superfluous—which latter assumption is in accord with expert opinion—the items will be:

Six stationary steam engines, 1,800 h. p. each, with boilers, costing, inclusive of erection	$270,000
Eight generating dynamos, each 1,350 h. p. capacity, inclusive of erection	278,375
One station house at East One Hundred and Twenty-ninth street, for the Second and Third avenue lines	20,000
One ditto at Battery for the Sixth and Ninth avenue lines	30,000
227 electro-motors at $3,000	681,000
Thirty-two miles central rail, 35 lbs. per yard, laid	40,000
Total	$1,311,375

This amount would in all likelihood be largely modified by the sale of the steam locomotives—which are of standard gauge—for use in short surface railways; but letting this probable rebate stand as an offset to unforeseen contingencies, the statement of current expense of electrical motive power and concomitant plant will be, taking an hour as the unit of time:

Interest upon and depreciation of installation at 10 per cent. per annum	$15.00
Total coal at 2 lbs. per h. p. and $3 per ton	28.93
Labor at power stations:	
2 chief and 4 assistant engineers at $22 per diem, 40 stokers at $80 per diem	4.25
Wages of 1 attendant per motor, 227 at $3 per diem	28.38
Total per hour	$76.56

It should be explained *en passant* that the lower rate per cent for depreciation of electrical machinery is based on superior durability due to its simplicity, few parts and the absence of reciprocating movement. This amount is the total current cost of the maximum work done in any one hour upon all the lines. In comparison with the same quantity obtained through steam locomotives, the ratio is about as 1 to 2.28. In other words, electricity will perform for $1 the identical work for which steam charges $2.28.

SALT LAKE DISTRICT TELEGRAPH.—A meeting of the stockholders of the District Telegraph Company of Salt Lake City was held at the company's office Feb. 12. The following directors were elected: C. F. Annett, F. D. Giles, W. H. Frost, G. S. Erb, F. C. Gentsch. The directors then met and elected the following officers: C. F. Annett, president; F. D. Giles, vice-president; W. H. Frost, secretary; F. C. Gentsch, treasurer; F. D. Giles, general manager. The business of the company is represented as in a flourishing condition, and everything indicates a successful outcome to the venture. It is already quite popular.

A Government Telegraph.

To the Editor of the Electrical World :

SIR: As an operator who has some knowledge of government telegraphs I shall be glad if you will permit me to ventilate my ideas. The question whether a government telegraph will be advantageous to the public is no concern to the operator. I have read the letter signed "SA.," in which he advocates the coalition of the telegraphs and the post-office, and I am afraid he is too sanguine in harboring hopes of telegraphers becoming postmasters. In the event of such a combination of departments it is scarcely likely that the postal department would become second to the telegraphs.

In my opinion it is unreasonable to expect a telegrapher to accustom himself to the intricacies of the post-office to such a degree of efficiency as shall benefit the public; and is it not equally unreasonable to expect a postmaster to make himself useful in a telegraph office? The two departments, I maintain, should be distinct in management.

In England the telegraphs are subordinate to the post-office, and postmasters who literally know nothing of the practical working of telegraph lines or offices are appointed to control them, but they are dragged through their difficulties by the manager of the operating room, and this is one of the bitterest grievances of the English operator. I am not aware of a single instance where an operator or a superintendent has been promoted to the postmastership of a large city. These plums are the property of postmasters only. Assuming a different state of affairs in this country, with the telegraphs under the absolute control of gentlemen who have acquired proficiency by practical means, a government telegraph will not be conducive to the interests of the operator. It is not likely that companies can stand against a powerful government. A monopoly being created the operator is left completely under the thumb of the government, and is thereby deprived of choice of employers. With a healthy competition there is more scope for his rapid progress. If he finds himself neglected or overlooked in one employ it is no difficult matter to enlist into another where his pay may be more equivalent to his qualification. Then, again, government promotion is not always rapid or just. Certainly it is progressive—about as progressive as a snail's galop, and the operator knows that by a record of good conduct he is safe for periodical increment of salary, and like the English operator of to-day the only interest he takes in his work is that portion of his duty which requires him to handle his salary, whereas in competitive service he is anxious to improve himself and show that he deserves extra remuneration for his superior attainments. With several competing companies there are opportunities given to an operator to obtain a prominent position, commanding a high salary, but where there is monopoly the number of these valuable appointments is reduced to a minimum and he has very little to look forward to.

Adverting to "SA.'s" advocacy of fixed or life terms with accruing pensions I opine that an operator who offers his life service makes himself a slow drudge, going to his business daily, satisfying himself with the fond illusion that he is one day nearer his pension. The energy of the operator can only be maintained by having a more lively object in view, and if the sluggish system referred to be adopted the public will be the first to regret the innovation. In England there are excellent operators who have been simply spoiled and have lost all heart and energy in their work because they are sure of promotion for good conduct. Emulation is a thing of the past, and knowing that he is entirely in government hands unless he can obtain a position in cable service the operator is compelled to bow to the inevitable, on a very low salary, too. Companies are more liberal than governments. It is therefore the chief aim of the English operator to disentangle himself from government service and join a cable company where there is good pay and also facility for promotion. It is an acknowledged fact that the smartest of English operators are in the cable service, and the number of applicants is a sufficient verdict against government telegraphy in England.

In this country probably the government would not demand such long hours of duty, and to many, no doubt, the prospect of a pension when a man has lost the majority of his senses, and can neither walk nor write, is a charming bait, but it won't suit the go-ahead American operator. He can see that by self improvement and assiduity he can attain a position which will enable him to provide his own pension. The idea of a pension often keeps a man from attempting to look out for himself; the country has, consequently, to pay for his servitude of sluggishness and inactivity of brain.

In conclusion, I may say that if the opinions of the operators were canvassed the majority would vote for competitive service, and view with dismal concern a government monopoly, even in its brightest aspect, with no fears for ins or outs.

SYLVANUS.

PHILADELPHIA, PA.

ADVANTAGES OF LONG DISTANCE TELEPHONY.—One advantage of the long-distance telephone will be that the reporters on the American dailies can tell the English authorities at once how to manage matters in Egypt instead of waiting for the slow process of sending a paper over, marked with a blue pencil.—*Boston Com. Bulletin.*

THE TELEGRAPH.

TELEGRAPH LINES IN CHILI.—A bill has passed the Chilian Congress empowering Messrs. Bolton and Dittborn to construct telegraph lines between Valparaiso and Lota.

THE FARADAY DELAYED.—The steamer Faraday, which left Queenstown recently with a portion of the new Bennett-Mackay cable on board, has returned to Portland, England. She has lost her propeller, and is to be surveyed at London. It is expected that the cable will nevertheless be laid by the time already announced.

THE COMMERCIAL CABLE.—The new Bennett-Mackay Cable Company will land one end of its cable on Cape Ann, Mass., and has bought land for this purpose at Cape Hedge, Long Beach. A cable station is to be erected at Rockport, the dimensions of which will be 60 by 45 feet and two stories high. The cable will be laid about two feet under ground for a distance of one and a quarter miles to the station in the town.

DEATH OF A MEXICAN MILLIONAIRE.—A dispatch from the city of Mexico, of Feb. 25, says: The funeral of the millionaire R. G. Guzman to-day was largely attended and very imposing. Mr. Guzman was Vice-President of the Mexican Cable Company, a director of the Mexican Central Railroad Company, and the principal owner of all the street railroads in the city. He also carried on a large commission business, and was heavily interested in the Guanajuato mines. By wonderful activity he had accumulated a large fortune in ten years.

THE RELIEF TELEGRAPH CO.—Articles of association of the Relief Telegraph Company were filed in the County Clerk's office, New York, on Feb. 23. The purpose of the company is to maintain wires connecting public offices, business houses, and private residences with each other and with the company's offices. Its capital stock is $25,000, divided into 250 shares, but the right to increase to $1,000,000 is reserved. The shares of the company are held as follows: Joseph B. Yerkes, of Plainfield, N. J., 200; Robert Clark, Jr., of Brooklyn, 30; Charles Ernest Wilson, of New York, 10, and Thomas N. Morgan, of New York, 10.

TO SEND TELEGRAMS BY TYPE-WRITERS.—Articles of association of a corporation to be known as the Public Postal Telegraph were filed in the County Clerk's office, New York, on Feb. 26. The corporation is to start with a capital stock of $100,000, divided into 1,000 shares of $100 each, held as follows: William D. Snow, of Rivervale, N. J.; Benjamin F. Blair, Frank Rudd and George M. Brooks, of New York, each 25 shares, and Ross C. Stone, of New York, 900 shares. One of the gentlemen interested in the company states that it would attempt to utilize an entirely new system of telegraphy. Type-writing machines were to be used in the sending and receiving of messages, and any operator on these could learn to send telegrams in two months. The reporter's informant admitted that the new system was yet largely theoretical.

TREATMENT OF LADY OPERATORS BY THE PUBLIC.—From the reported remarks of a handsome young lady employed as receiving clerk in a telegraph office: "Upon my word, it doesn't seem to me that the men who do business have brains enough to keep them out of the poorhouse, if they had to work for other people. You've no idea how difficult it is to strike just the right sort of demeanor in a place like this. The manager tells us that we must be nice and amiable, and never curt or saucy. That is all very well, but we soon find that it won't do to obey these orders too fully. It don't take more than half a smile, or more than a word sweetly spoken, to excite insulting familiarity in a good many customers. I get mad enough twenty times a day to strike my fist right through that wicket into their silly, aggravating, mawkish faces."

AN IMPORTANT LEGAL DECISION.—The Supreme Court of Georgia, in the case of the Western Union Telegraph Company against Shotter, from Savannah, Ga., has decided that a telegraph company is responsible for the gross negligence of its agents in transmitting messages in damages to the party injured, and declares that it is immaterial what condition a telegraph company puts upon the printed heading of its message blanks, so far as its liability for negligence is concerned. It is bound to discharge its duty to the public with skill and diligence, and to be accurate in the discharge of such duty, even if it be necessary to repeat messages in order to insure accuracy. Where the sender of a telegram offered certain merchandise at a specified price, but through the negligence of the telegraph company the message was so sent as to name a lower price, and upon the acceptance of the offer he settled with his correspondent at a lower price, the measure of his recovery against the company would be the difference between what he actually received for the property and what he would have received but for the mistake.

THE TELEPHONE.

"THE CASE EXPLAINED."—The Overland Telephone Co., of this city, has issued a pamphlet under the above title, containing the text of the recent decision in the injunction proceedings at Philadelphia, and editorial articles on the subject, not favorable to the Bell Company, from the Newark *Daily Journal* and the New York *Journal of Commerce.*

IN WESTERN PENNSYLVANIA.—The Citizens' Telephone Co., operating in nine counties in Western Pennsylvania, and organized a few weeks ago, has now in use 50 sets of instruments at Pittsburgh, Pa., and has orders on its books for about 200 more. It uses the Bowen patent. Mr. S. A. Duncan, Superintendent of the Brush Electric Light Co., of that city, is one of the projectors and a large stockholder in the company.

WEDDING BELLS.—The Gunnison, Col., *News Democrat* announces the marriage of Mr. James A. Dofflemyre, manager of the telephone exchange, to Miss Jennie I. Pomeroy, on the 13th Feb. and says: "We take this occasion to compliment Manager Dofflemyre for the splendid work he has done in building up and popularizing the telephone business in this city. When he took hold the affairs of the company were at a low ebb, but by attention to business and by uniform courtesy to the patrons of the line he has undone much of the mischief of his predecessors and has worked the business up until it is now in a flourishing condition. He is exactly the right man in the right place, and we hope the company will have the good sense to retain his services as long as possible. They could not have a better man in charge."

A LEAP YEAR PARTY.—The girls employed in the telephone operating room, reports the Lowell *Courier*, of Feb. 20, with a few of their female friends outside, gave a leap year party last evening at the mansion house of the telephone syndicate farm in Chelmsford, which proved a very enjoyable affair. Including a few invited guests the party numbered between 30 and 40 couples, who were transported in a barge and in hacks from Lowell to the farm, where they were hospitably received and entertained by Mr. and Mrs. Oliver, who have charge of the premises. The reverse order of affairs was fully sustained throughout and was the cause of much merriment. The early part of the evening was occupied in playing games, interspersed with piano and other instrumental music and singing by Mrs. C. J. Glidden, Miss Mabel H. Chase and Charles L. Abbott. Later dancing was introduced and kept up until past midnight, an excellent supper being served during intermission by Mrs. Oliver. Messrs. Ingham, Glidden and Downs, with their wives, were present and entered heartily into the enjoyment of the occasion. The girls saw their young men safely home about half-past one this morning and February 19 is registered as a red-letter day in their existence.

THE ELECTRIC LIGHT.

THE DOUGLAS ENGINE.—Mr. Frank Douglas, of Chicago, Ill., has recently completed and shipped to the Bloomington Electric Light Company, of Bloomington, Ill., a 100-horse-power Douglas improved automatic cut-off engine.

AN IMPORTANT PATENT CASE.—The Secretary of the Interior heard argument by counsel this week, at Washington, in the case of Edison *vs.* Sawyer & Mann, involving the patent for incandescent electric lamps. The decision of the Commissioner of Patents awarded priority of invention to Sawyer & Mann, and Edison appealed from that decision. Mr. Roscoe Conkling appeared at the hearing for Mr. Edison, and Mr. Broadnax, of New York, for Sawyer & Mann.

A SPECIAL ARMINGTON-SIMS ENGINE.—A special engine designed for the Edison Electric Light Company, to be used in connection with their dynamo on steamers and steamships where a boiler pressure of 40 pounds is obtainable, has been built by the Armington & Sims Engine Company, of Providence, R. I. This concern has also shipped one of its engines to the Bridgeport Electric Light Company, of Bridgeport, Conn., and two engines to the Brush Electric Light Company, of Norfolk, Va.

THE BAXTER LAMP.—The Keystone Electric Co. has been organized as the sole licensee for Pennsylvania of the Baxter Electric Light Co., with a capital of $500,000. Twenty-five per cent. of the capital stock is in the treasury, and forty-five per cent. is given to the Baxter Co. for the privileges conferred. Mr. W. H. Griffitts, secretary of the Keystone Co., has exchanged contracts with the Baxter Co., and the stock due to the latter has already been covered into its treasury. The Keystone Co. has a good cash working capital, and is already treating with towns in the State for electric lighting, and has orders for the Baxter attachments, which will work on all the well-known arc light systems. The stock has been quoted in Philadelphia at 21.

THE PROGRESS OF THE BRUSH CO.—Mr. C. C. Curtiss, the General Agent of the Brush Electric Co., is about as busy as he can be in attending to the new companies organizing in every direction. He has personally organized recently the Elkhart Lighting Co., Elkhart, Ind., and the Canton Electric Light Co., Canton, O. Plants are already running in both of these cities. On the 13th February he closed a contract with, and organized, the Erie County Lighting Co., Erie, Pa., with a capital of $100,000; and the order has been given to have the plant put in at once. On the 23d he organized the Brush Electric Lighting Co. of Lafayette, Ind., capital $30,000, and in this case, too, the order has been given for the immediate shipment of the plant.

LESS TALLOW WANTED IN RUSSIA.—The following account is given of partial success with an installation at St. Petersburg: On Christmas Eve the chief streets of St. Petersburg were for the first time illuminated by electricity, the brilliant light, according to Russian papers, turning night into day. Its success seemed perfect, but unfortunately it was only on that night that the inhabitants were allowed to enjoy the full advantage of the light. The next night it was only after several hours of darkness on one side of the Nevski Prospect that all the lamps were lighted, and since then it has been found that some time must elapse before the new installation will be perfected so as to afford continuous illumination every night.

MISCELLANEOUS NOTES.

RIPENING WINES.—Ripening and purifying wines and strong liquors is done by the Electric Liquor Company, of California, by means of an electric current. By this process the liquor is freed from all its poisonous essential oils and the work of from three to six years is done in a few hours. Light clarets are treated in three to six hours. Brandy requires sixty.

ROLL CALLS BY ELECTRICITY.—Architect Clark has assigned a room in the main portion of the Capitol at Washington to thoroughly test the electric teller and recorder for legislative bodies, invented by Mr. F. W. Crosby and Charles Williams of Boston. By this electric system it is claimed that a yea and nay vote can be taken in the house in two minutes. Besides taking it, the roll is printed on a slip, and can be immediately read by the clerk.

A MAGNETIC INDUCTION COMPASS.—M. Mascart's magnetic induction compass comprises an azimuth circle upon which moves an arrangement carrying a ring movable on a horizontal axle; the angle which this ring makes with the horizon is measured by a vertical circle; the frame, 0.12 metre in diameter, is supported by the ring, and can turn upon an axle perpendicular to that of the ring. The dimensions of the instrument are not greater than those of an inclination compass.

A MOTOR FOR STREET CARS.—Chas. F. Brush, the electrician, with his assistants in Cleveland, is, says the *Elevated Railway Journal* of Feb. 23, perfecting a new electric motor at the electric light works there, to be used on street cars. The motor, which is to be stationed on the front or rear platform of the car and there manipulated at the will of the conductor, is to be

supplied with power from the Brush storage battery. The work of laying tracks for experimental purposes is almost completed, and it is expected that everything will be ready for public exhibition the early part of next month.

THE CORRECTION OF GALVANOMETERS.—It happens, remarks *Engineering*, that the value of a division of the galvanometer scale is sometimes altered by a charge of magnetism in the directing magnet. To correct this error M. Ducretet now winds that magnet with a coil of wire, thus transforming it into an electro-magnet which he magnetizes by an electric current at will in order to bring it to its proper standard strength. This device has been applied by him to his well-known universal galvanometer, but it is applicable to all galvanometers having directing magnets. A simple electro-magnet having a soft iron core magnetized during observations by the current of a standard Daniell cell is also substituted by him for the directing magnet.

THE ELECTRIC, MANUFACTURING AND MISCELLANEOUS STOCK EXCHANGE.—John A. Belvin has been elected President of the Electric, Manufacturing and Miscellaneous Stock Exchange, in place of George M. Hard, resigned. Mr. Belvin is President of the Standard Gas Company. The *Evening Stock Report* says: "Mr. Belvin is a retired merchant of high character and standing, and ample experience as a member of the leading Western and Southwestern Exchanges. He will be no mere figurehead, but will devote his best energies and ability daily to the duties of the position to which he has been elected. The stockholders may rest assured that their interests will be fully protected in his hands, and that his administration of his trust will be uninfluenced by either 'fear, favor or affection.'" Mr. E. S. Benedict, of W. P. Humbert & Co., has been elected a director.

A NATIONAL COURT OF ARBITRATION.—One of the last "crank" schemes before Congress is a bill to establish a National Court of Arbitration, to regulate inter-State commerce, to consist of a Chief Justice and four Judges, appointed by the President, who are to sit in Washington. None of its members shall be interested as stockholder or director in any railroad, telegraph, telephone, manufacturing or mining corporation. Power is given to the court to determine the compensation for skilled or unskilled labor, performed for any corporation or person whose interest extends into two or more States. It is to fix the maximum freight and passenger rates of inter-State common carriers, determine parlor and sleeping car rates, and fix the rates for telegraph and telephone messages. Any citizen or corporation having cause for complaint against any other person or corporation in relation to subjects over which the Court of Arbitration has jurisdiction, may bring suit in that court, which is authorized to try such cases, and its finding is made final and conclusive, unless an appeal be taken to the Supreme Court of the United States. Other sections of the bill contain provisions for enabling the court to perform its duties.

COPPER AND OTHER WIRES.—Mr. W. H. Preece recently gave at the Institution of Civil Engineers, some interesting information on the subject of wire conductors for electrical purposes. Copper is, he said, almost universally used for insulated conductors, and the manufacture has been so much improved that it is now twice as good it was in 1856. Copper wire has a breaking strain of 28 tons per square inch, while iron wire breaks with 22 tons. The best copper comes from Japan, Chili, Australia and Lake Superior, but a great deal of pure copper is obtainable by electro deposition. The ordinary best puddled iron is at present used only for fencing purposes, but a mild English Bessemer steel is largely used for railway telegraphs and for stays, although the resistance is very high, owing to the presence of manganese. The wire used by the post office is made from Swedish charcoal-iron. Swedish Bessemer, or a specially-prepared low carbon English Bessemer, is adopted by the Indian Government. Cast-steel wire, with a breaking weight of about 80 tons to the square inch, has been adopted on the Continent for telephone currents; while in England, where speed of working is the prime consideration, electricians are satisfied with a breaking strain of 22 tons on the square inch. In the colonies, where long spans are essential and speed of working is not so important, the specification is 30 tons on the square inch.

STOCK QUOTATIONS.

Telegraph, telephone and electric light stocks were quoted as follows on Wednesday at the Electric Manufacturing and Miscellaneous Stock Exchange, and at the Stock Exchange:

TELEGRAPH.—Am. Cable, b 57½, a 59¾; Am. R., b 50, a 65; B. & M. Co., a 125; Commercial Telegram Co., a 80; Mexican, b 125, a 147; Mut. Union, b 15½, a 16; Western Union, b 75½, a 75⅝.

TELEPHONE.—American Bell, a 172; American Speaking, b 110, a 125; Currier-Telephone Bell, b 2; Colombia and Panama, b 19.87, a 20; Continental, b 12; Dolbear, b 5, a 10; Globe, b 8, a 20; Hudson River, b 60, a 90; Inter-Continental, b 75; Mexican, b 2.50, a 2.75; Mexican Central, a 3; Molecular, b 5, a 15; New York, a 85; New York and New Jersey, a 80; New York and Pennsylvania, b 50, a 82; Overland, b 6, a 20; People's, b 9, a 11; People's (N. E.), b 1.50; Shaw, b 10; Solenoid, a 125; Southern Bell, b 95, a 125; Southern New England, a 175; Tropical, b 1.50, a 2; West India Telegraph and Telephone, b 1.95, a 2.

The Boston *Advertiser* of the 28th says of the local market: Telephone stocks were weaker. American Bell declined from 172½ to 170@170⅛; New England from 37 to 34⅛@34¼.

ELECTRIC LIGHT.—American, b 4.90, a 6; Brush b 50, a 80. Brush Illuminating, b 50, a 65; Daft, a 85; Edison, b 130, a 170; Edison Illuminating, a 65; Edison Isolated, b 50, a 100; Edison European, b 3, a 15; Excelsior, a 28; Swan Incandescent, a 40; United States, a 110; United States Illuminating Company, a 95.

BUSINESS NOTICES.

MILLER'S BATTERY CARBONS.—D. G. Miller, 44 Wyckliffe street, Newark, N. J., publishes a price list of his battery carbons, manufactured only from pure retort carbon. It gives full particulars as to length, width, thickness and price. Special sizes are cut as required. The prices are moderate and lead to large orders.

WILKES & FRANCIS.—This firm, of 113 Nassau street, New York, manufacturers of all kinds of electrical instruments, burglar alarms, etc., are making some very tempting offers. Taking a hint from the numerous burglaries in flats, they have perfected a cheap and reliable system of burglar alarms as a protection against burglars and sneak thieves.

THE ELECTRIC GAS LIGHTING CO., BOSTON.—This company, of 45 Milk street, Boston, Mass., has issued a new Price List—List A., 1884. It is an illustrated catalogue with prices of patent electric gas-lighting apparatus, together with all appliances and supplies needed in connection therewith, and will be found valuable by all seeking information on the subject.

THE BUFFALO ELECTRIC WORKS.—The management of these works, 1,590 to 1,620 Niagara street, Buffalo, N. Y., call attention to the carbon point they are now manufacturing for electric light purposes. They say: "It has been our aim to produce a carbon which, while it preserves the intensity, will give a pure white light and avoid the unpleasant shifting of the arc from one side to the other, and still burn as long as, or longer than, any other. We know we have attained this from our own tests and also from the fact that, without a single exception, we are now selling our points wherever they have been tried." They furnish carbons in any shape and size. Mr. A. L. Arey, one of the trustees, and the manager, was formerly connected with the electrical business in Cleveland, O., as was Mr. J. A. Lannert, the Superintendent.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

Edited by N. S. KEITH, Electrical Engineer and Expert, 237 Broadway, New York.

PATENTS DATED FEB. 12, 1884.

Asphaltic-Concrete Conduit; Wm. W. Averell, of Bath, N. Y. 293,214

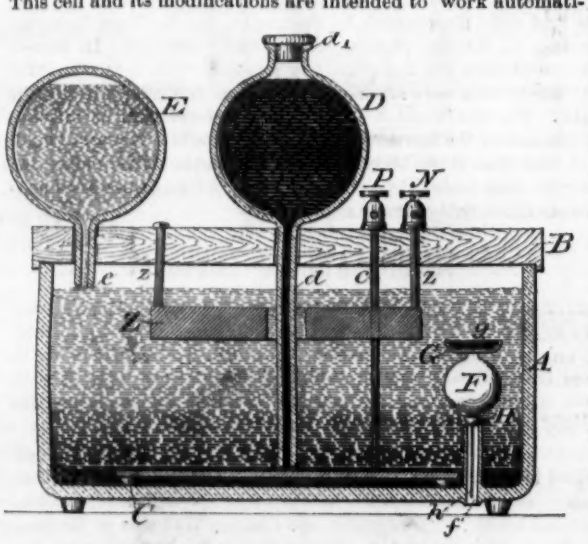
A ditch is dug; asphaltic-concrete is laid upon ordinary hydraulic-concrete along the bottom of the ditch; insulated wires are laid in parallel on the concrete; then more concrete and more insulated wires in layers until the desired number of wires are laid. The whole is covered with concrete and pavement. The distinctive feature consists in proportioning the components of the concrete.

Combined Gas and Electric Lamp Fixture; Sigmund Bergmann, of New York, N. Y., assignor to Bergmann & Co. of same place 293,553

The bracket is capable of being folded or swung in any manner, while both the gas and electrical connections are maintained.

Automatic Feeding Apparatus for Voltaic Batteries; Frank L. Pope, of Elizabeth, N. J. 293,272

This cell and its modifications are intended to work automatically in keeping a proper supply of water, sulphate of copper, and also the proper relative differences in the density of the two solutions of zinc and copper. *C* is the copper electrode and *Z* the zinc. *E* is a vessel containing water, and *D* a vessel containing a saturated solution of sulphate of copper. *F* is a float which carries the valve *H*, which closes the outlet *f*. When the solution of sulphate of zinc has acquired a certain density, the float *F* rises and some of the solution flows out of the vessel through the outlet *f*. This lowers the surface of the liquid so that water from *E* flows in to decrease the density. When this has taken place the float descends and closes the outlet.



Electrical Extension-Bracket; J. Edwin Giles, of Hazleton, Pa. 293,318

Telescoping tubes are so mounted to form a bracket for an incandescence lamp, that they may be extended by pulling to any extent, and, at the same time, preserve the electrical connections.

Holder for Incandescent Electric Lamps; Jean Lauguereau, of Paris, France 293,256

Possesses some novel features.

Dynamo-Electric Machine; Frederick K. Fitch, of New York, N. Y. 293,441

The field-magnet pole-pieces have annular recesses, within which the compound ring-armature is moved. Novel means of mounting the rings on the spider are provided.

Electric Railway-Signal; James C. Upham, of North Sydney, and John P. Rogers, of Elmsdale, Nova Scotia, Canada 293,381

Comprises an arrangement of parts, by which the engineers of approaching trains may signal each other.

Electrical Generator or Motor; Thomas A. Edison, of Menlo Park, N. J. 293,432

Sparking at the commutators of dynamos is prevented by opposing a counter-electromotive force to the electromotive force of the armature coils as they are short circuited by the brushes.

Electric Bell-Ringing Apparatus; Oscar Gassett, of Boston, Mass. 293,571

A novel arrangement of mechanism for the purpose of ringing alarms or signals.

Electric Battery; Charles L. Clark and John Leigh, of Manchester, county of Lancaster, England, assignors to the Domestic Electric Manufacturing Co., of New York, N. Y. 293,563

An electric battery cell, consisting of a vessel containing zinc and silver-foil and chloride of silver, with a solution of an alkaline sulphate as an excitant.

Electric Motor; Walter Bradbury, of St. Louis, Mo., assignor to George S. Calhoun, of same place 293,556

The armature pole faces have ribs of double V-shaped form, and corresponding depressions are made in the field-magnet pole-faces to receive the ribs. This is for the purpose of avoiding dead centres.

Insulator for Electric Wires; Albert W. Hale, of Plainfield, N. J. 293,242

A screw with a cross-shaped head is covered with an insulating glaze, and is screwed to place as a substitute for insulating caps or cups.

Insulation of Railroad-Tracks used for Electric Currents; Thomas A. Edison, of Menlo Park, N. J., assignor, by mesne assignments, to The Electric Railway Company of the United States, of New York. 293,433

The rail is provided with an insulated covering for the foot and web, placed between those parts and the tie and spike.

Incandescent Electric Lamps; Thomas A. Edison, of Menlo Park, N. J., assignor to The Edison Electric Light Company, of New York, N. Y. 293,434

A device for holding an end of the carbon filament, which consists of a flat piece of copper bent twice lengthwise upon itself, the end of the filament being compressed in one of the folds.

Lightning Diffuser; Leonidas G. Woolley, of Indianapolis, Ind. 293,612

The electrical conductors are placed in vertical position and have points at both upper and lower ends; and are held in place by supports which are adjustable to the various angles of a building upon which they may be placed.

Magnet; Charles M. Many, of Brooklyn, N. Y. 293,33

Has a dove-tailed connection between magnet and armature.

Voltaic Arc Lamp; Otto A. Moses, of New York, N. Y. 293,495

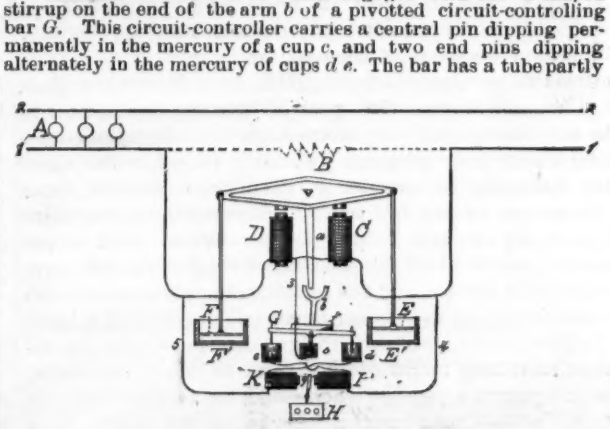
An arc lamp is provided with two paths for the current: One through the carbons alone, and the other through the regulating mechanism and the carbons. Means are provided for passing the current alternately through these two circuits. When passed through the latter circuit the light appears, and the reverse is the case when the current flows in the other circuit. This enables the lamp to be used for signaling.

Means for Electrically Locating and Following Veins of Metal in the Earth; Jerome Prince, of Milford, assignor, by direct and mesne assignments, to August P. Lighthill, of Boston, Mass. 293,518

A block of insulating material carries two separated metallic pins or posts, which are each connected to one or the other of the poles of a source of electricity. In the electric circuit an alarm bell is included. The pins or posts are pushed or driven into the ground, and when they touch better conducting material than the earth, such as metal, enough current flows in the circuit to ring the alarm-bell.

Electrical Meter; Thomas A. Edison, of Menlo Park, N. J., assignor to The Edison Electric Light Company, of New York, N. Y. 293,434

An oscillatory beam, actuated by electro-magnets either in the main or in a shunt circuit, causes the movements of a recording apparatus. *B* is a pivotted beam carrying armatures on opposite sides of its pivots, acted upon by the electro-magnets *C D*. The beam is connected at its ends with the dash-pot plungers *E* and *F*. The beam has an arm *a*, which engages with the U-shaped stirrup on the end of the arm *b* of a pivotted circuit-controlling bar *G*. This circuit-controller carries a central pin dipping permanently in the mercury of a cup *c*, and two end pins dipping alternately in the mercury of cups *d e*. The bar has a tube partly



filled with mercury secured thereto, for throwing the circuit-controller to the limit of its movement after it is tipped over the centre by the movement of the beam *B*. *H* is the recording mechanism worked by two electro-magnets *I K*, which act alternately on the armature-lever *g*. The movements of the beams throw the electro-magnets alternately out and in circuit in an obvious manner to continue the oscillations.

Socket for Electric Lamps; Sigmund Bergmann, of New York, N. Y., assignor to Bergmann & Co. of same place 293,552

A combined socket and shade-holder. The latter may be removed and replaced without disturbing the former.

Telephone Transmitter; Henry C. Buck, of Somerville, assignor to Francis M. Holmes, of Boston, Mass. 293,561

One electrode leans against the electrode attached to the diaphragm. The pressure is regulated by the angle of inclination, which can be determined by moving the base of the electrode-holder backward or forward.

Underground Wire Conduit; Thomas L. Smith, of New York, N. Y., assignor of one-half to Daniel A. Mathews, of same place 293,533

The conduit-pipe is made in sectional lengths, and each section is provided with one or more transverse bridges, having recesses or notches, in which the wires are laid and supported thereby. Glass plates are laid over the sloping sides of the bridges to protect the wires.